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VEGETATION AND SOILS OF THE CROWLEY CREEK WATERSHED

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A C K N O W L E D G M E N T S

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VEGETATION AND SOILS

of the

CROWLEY CREEK WATERSHED

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INTRODUCTION

Crowley Creek Watershed is located about 15 airline miles northwest of Orovada, Nevada, in Humboldt County (Fig. 1). The basin includes approximately 72 square miles.

The watershed lies in the northern part of the Great Basin within the Basin and Range Physiographic Province and consists of north-south trending mountains separated by small valleys or deep canyons. The altitude of the highest peak is 7,096 feet and the basin outlet is approximately 4,432 feet. Relief between the mountains and adjoining valleys or canyons rarely exceed 1,600 feet.

Geologic parent materials consist mainly of Rhyolitic and Dacitic volcanic rocks and alluvium.

Crowley Creek is a perennial stream, while ephemeral streams in the basin flow briefly following snow melt or thunderstorms. A number of perennial springs are found throughout the watershed.

The climate of the basin is semiarid. Annual precipitation for a 4-year period (1963-1966) ranged from 7.6 to 13.7 inches. Comparisons with records at Orovada indicated one above average year, one near average, one below average and one drought year with one-half the average precipitation. During 1911 to 1964 the approximate temperature at the lower elevations of the basin ranged from a low of -35°F to a high of 115°F with the average annual temperature of 48°F.

The vegetation of the watershed belongs to the northern desert shrub vegetation zone and is characterized by big sagebrush, low sagebrush, meadow, and aspen associations. The soils are mostly Aridisols with a few Mollisols.

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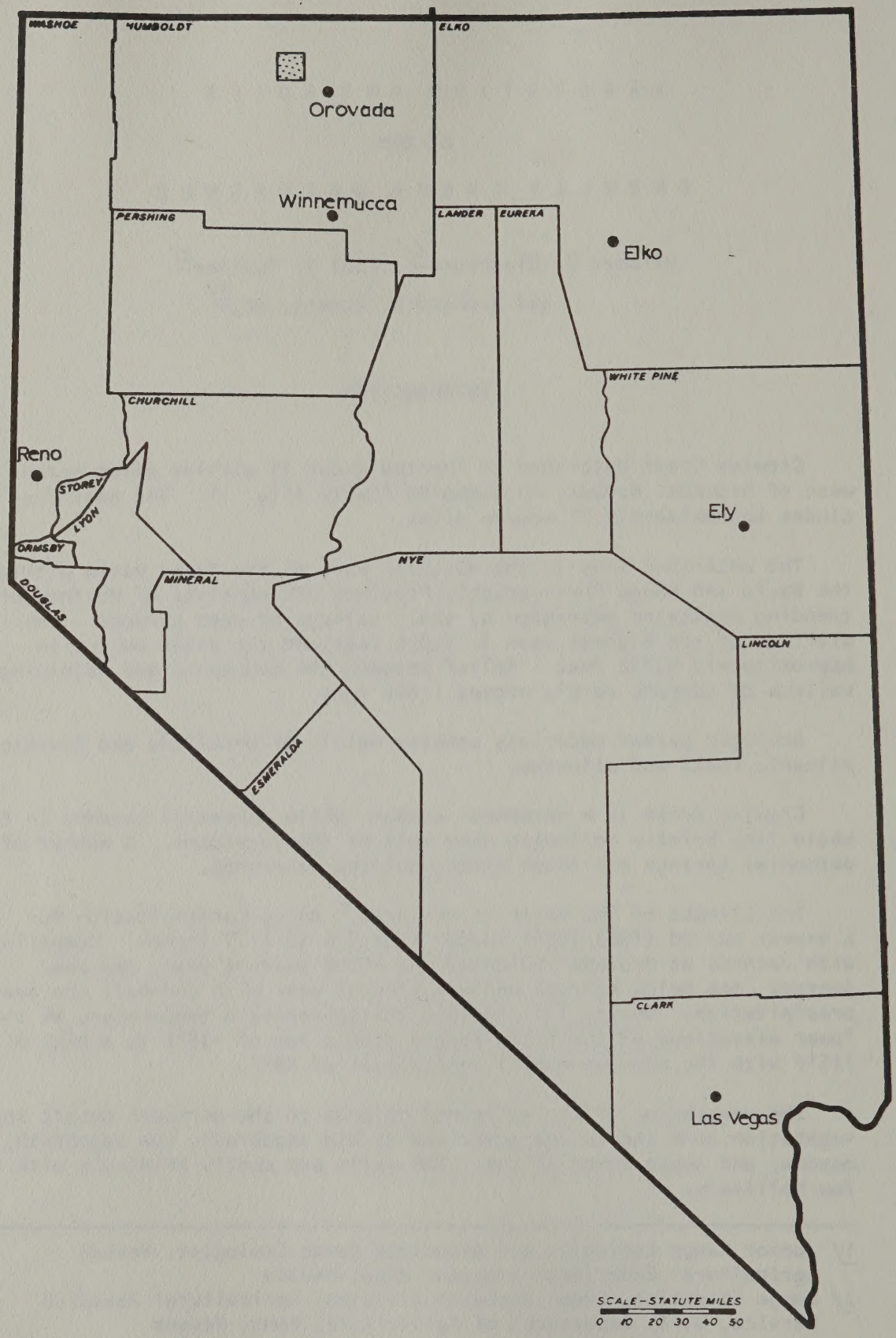

Figure 1. ⊠ Location of The Crowley Creek Watershed in Nevada

Cattle grazing is the primary land use. Cattle have been associated with depletion of grass stands, and the increase of woody plants. The result has been an apparent decrease in grass production in the basin.

Land managers constantly require factual information upon which to base their programs. There is need for detailed data concerning vegetation and soils on range lands. Material included in this report describes the climax and seral units of vegetation and associated soils in the Crowley Creek Watershed. It is one of 12 range watershed study areas in Nevada administered by the US Department of Interior, Bureau of Land Management. The vegetation-soil analysis herein reported is a portion of a cooperative research effort between the Bureau of Land Management and the Renewable Resources Center of the University of Nevada.

This study was designed as a multiple-purpose ecological inventory of vegetation and soil resources. The study provides fundamental information which can be interpreted and re-interpreted as use patterns change and as understanding increases without the need for a complete re-survey as new uses are emphasized.

The value of the data outlined in this report lies in the development of relationships between vegetation and soil and the resultant indicator significance of vegetation. For example, a classification of the basic ecological units is necessary for a thorough understanding of the landscape and for interpretation of site potential. However, site potential for a given vegetation-soil grouping requires further analyses and the accumulation of data about the value of a management practice if it were applied to the grouping in question. Much of these data are not yet available. Any management recommendation made in this report is curtailed due to a lack of such data related to vegetation-soil groupings described herein. However, when such data become available the manager will be able to easily identify sites within the confines of his land unit upon which a given practice or management program has been found to be desirable. An enhanced ability to precisely define range landscapes constitutes the real value of this analysis.

We have attempted to define the vegetation-soil groupings on the basis of a habitat-type classification. A habitat-type, as defined by Daubenmire (1952) is "the collective area which is capable of supporting the same homogeneous climax plant association." By collective area is meant a unique ecological entity which can be delineated on a map or aerial photograph. The habitat-type concept indexes site potential since it is an expression of the ultimate unit of the environment with regard to vegetation, soil classification unit, topographic placement and, by inference, micro- and mesoclimatic factors.

As an example, we have interpreted the *Artemisia tridentata/Agropyron spicatum* community to be a habitat-type based on its homogeneity, recurrence, productivity, relict areas and apparent equilibrium with its environment. When a community is not climax, careful evaluation of plant, soil physiographic and climatological data are necessary in order to speculate as to the probable habitat-type with its specific potential. The *Artemisia arbuscula/Poa secunda* community is an example of seral vegetation. Remnant *Festuca idahoensis* plants were found in this community and the community occurred on the same soil with the same physiographic placement and similar climate as *A. arbuscula/F. idahoensis* stands found elsewhere within the basin. On these bases the *A. arbuscula/Poa secunda* community was interpreted to be an *A. arbuscula/F. idahoensis* habitat-type.

Similar evaluations have been made for most of the communities recognized in the watershed.

The first section of this report is a dichotomous key to the 11 plant communities. This key refers the reader to the second section, a detailed description of each community. The third section is devoted to a discussion and management suitabilities for the watershed. This is followed by the appendices which consist of precipitation data, soil families and sub-groups as associated with the watershed plant communities, and vegetation and soil association table. Finally, a watershed map illustrates mapping units which consists of plant communities with their respective percentages indicated, major drainages, roads, precipitation recording stations, townships, ranges and sections.

METHODOLOGY

Vegetation of the Crowley Creek Watershed was delineated into plant communities during a reconnaissance. As a general rule, all communities were recognized and delineated on the basis of vegetative characteristics alone. Then as soil and physiographic data were accumulated, this initial delineation was re-evaluated on several occasions until the 11 plant communities described in this report were finally identified and interpreted. These communities were given names corresponding to the major dominant and sub-dominant species.

Tree or Large Shrub Cover Data

Cover data of trees and large shrubs were obtained using the point method (Levy & Madden, 1933).

Basal Area and Cover Data

After the plant communities were delineated, an intensive study was initiated by an adaptation of methods described by Poulton and Tisdale (1961) and further modified by Tueller (1962).

A 100-foot square macroplot was used. Five plots were considered ample to adequately describe a community (Eckert, 1957) but on minor or inaccessible communities only one or two plots were used.

Permanent macroplots were established by running a 100-foot baseline up and down the slope. Plots placed on the level were oriented north and south.

Within each macroplot, four 4- x 50-foot belt transects were randomly located perpendicular to the baseline. Randomization was restricted to prevent transect overlap and to provide for two transects each in the upper and lower half of the macroplots. This two-way randomization provides for adequate sampling of the full length of the macroplot (Eckert, 1957).

Each belt transect was divided into ten 4- x 5-foot plots, thus enabling forty 4- x 5-foot plots to be studied in each macroplot. Two kinds of data were obtained from each plot: (1) basal area of the more abundant grasses and herbs, and (2) crown cover estimates of shrubs. A 1-square-foot frame was used as an estimation guide for both basal area and crown cover data.

Basal area was selected because it is relatively free from yearly weather variations and grazing influences (Tueller, 1962). Dead centers which exceeded 25 percent of the area of bunchgrasses were excluded from the estimate. Basal area estimates by species were based on the following cover classes (Poulton, 1962):

Class	Class Range Percent	Midpoint Percent
1	0 - 1	0.5
2	1+ - 5	2.5
3	5+ - 10	7.5
4	10+ - 25	17.5
5	25+ - 50	37.5
6	50+ - 75	62.5
7	75+ - 95	85.0
8	95+ - 100	97.5

The midpoint of each class range was used in calculating cover percentage.

Shrub crown cover estimates were obtained by standing directly over the shrub and projecting the foliage cover onto the ground. Estimates were made for each species to the nearest 1 percent of the 4- x 5-foot plot. Openings in the canopy larger than one-quarter of a square foot were not included.

Cover data of understory species in the meadow and aspen communities were obtained by using the point frame method as described by Levy and Madden (1933).

Frequency Data

Frequency, according to Cain and Castro (1959) is percent presence in plots of a stated size. For example, if a sample of a stand consists of 200 plots, and if one or more plants of a given species occurs in 50 of these plots, the species has a frequency percentage of 25.

Frequency sampling procedures developed by Hyder et al. (1963) were used to supplement cover estimates in each macroplot. Although frequency data are difficult to interpret, the speed and objectivity inherent in the method makes them useful when comparing areas where high statistical precision is needed (Tueller, 1962). Ten frequency transects, each with 20 presence or absence determination quadrats, were located perpendicular to the baseline. Each transect consisted of twenty 20 x 20-inch, 12 x 12-inch, or 3 x 3-inch quadrats placed contiguously and moving away from the baseline. Only those plants rooted inside the frequency quadrats were recorded. A two-stage randomization was applied to these transects: (1) restricting five transects to each half of the macroplot, and (2) preventing transect overlap.

Nonliving Ground Cover

Nonliving ground cover was determined by an adaptation of the point frame method as described by Goddall (1952). The same 200 frequency plots were used to sample cover but instead of recording presence of each species, the bottom tip end of the frequency frame was used as a point. Hits of bare ground, litter, pavement (1/4 to 1-inch diameter), and rock (1-inch plus diameter), and vegetation (only in the *Carex vesnacula/Poa secunda* and *Populus tremuloides* communities) were recorded.

Constancy

Cain and Castro (1959) define constancy as "the percentage of occurrence of a species on samples of the same size in various stands of a community type."

Species constancy percentages were calculated for each macroplot. In order to develop a complete species list for constancy, each 100- x 100-square foot macroplot was examined carefully after obtaining cover and frequency data, additional species encountered were added to the list.

Topographic and Physiographic Features

Topographic features of each macroplot were characterized as follows: position on the slope whether top, upper one-third, center one-third, lower one-third, or bottom; slope in percent obtained from an abney level; and aspect from an 8-point compass.

Physiographic placement of each macroplot was characterized as follows: land form -- drainage bottom, escarpment, fan, floodplain, plateau, flooded depression, ridge top, slope, lake-marine, or river terrace; macrorelief -- flat, undulating, rolling, butte, hilly, or mountainous; microrelief -- uniform, flat, convex, concave, interrupted, mount, pits, ridge and swale.

Soils Study

A soil profile description was made at each macroplot using the procedures outlined in the Soil Survey Manual (1951) and the Seventh Approximation (1960) plus revisions (1967). Horizons, soil color, texture, pH (by thymol blue, bromthymol blue and cresol red indicators), lime content, structure, and consistence were noted for each profile.

Lack of time and money prevented complete laboratory soil analyses. The following parameters were selected because they have been suggested to be indicative of vegetation and soil relationships (Eckert, 1957). Samples from the A_1 and B_2 horizons were analyzed and conductivity (millimhos per centimeter), pH (from a saturated paste), and organic matter (percent). Cation exchange capacity (milliequivalents per 100 grams) was determined only on those samples from the A_1 horizon (USDA Handbook No. 60, 1954).

Family level identifications were made as found in the Seventh Approximation (1960) and revisions (1967). When more than one profile description per family occurred, the model description was used to note that soil family.

Each soil family was classified as to hydrologic group (Nevada Department of Conservation and Natural Resources and the USDA, 1965); stoniness (USDA, 1951); and estimated water holding capacity based on clay minerology and texture (Schockley, 1955). Available water holding capacity was estimated for the rooting depth or to the depth of the soil profile studied if not otherwise stated. Rooting depths were limited by duripans and lithic or paralithic contact.

Soil boundaries were not physically located and a soil map was not made. Thus detailed comparisons of soils across the boundary were not possible or within the scope of this study. Only the soils noted at the macroplot were described. The kinds of soils noted at the macroplots were probably commonly associated with the different kinds of vegetation in this watershed.

Climatic Data

Precipitation data were taken for a 4-year period (1963-1966) from non-recording rain gages placed throughout the watershed. The data were then related to each applicable community in inches of annual precipitation.

Temperatures were estimated from existing records at Orovada, located 15 miles to the southeast. It has a climate similar to that of the lower elevations of the watershed.

KEY TO THE PLANT COMMUNITIES in the CROWLEY CREEK WATERSHED

A. Communities with an aspen (*Populus tremuloides*) overstory.

B. *Achillea lanulosa* dominant in the understory
. . . .*Populus tremuloides* community (P.31).

AA. Communities <u>without</u> an aspen (*Populus tremuloides*)overstory.

B. Communities dominated by *Artemisia*.

C. Communities dominated by *Artemisia arbuscula*.

D. *Festuca idahoensis* understory usually occurs on north-facing slopes and may have a high frequency of *Poa secunda*
Artemisia arbuscula/Festuca idahoensis Community (P.11).

DD. *Poa secunda* understory occurs on all aspects with only a trace of *Festuca idahoensis*.
..... *Artemisia arbuscula/Poa secunda* community (P.13).

CC. Communities dominated by *Artemisia longiloba*.

D. *Poa secunda* understory occurs on all aspects with a trace of *Festuca idahoensis*.
..... *Artemisia longiloba/Poa secunda* community (P.15).

CCC. Communities dominated by *Artemisia tridentata*.

D. *Agropyron spicatum* understory.....
Artemisia tridentata/Agropyron spicatum community (P.17).

DD. *Bromus tectorum* understory.....
Artemisia tridentata/Bromus tectorum community (P.19).

DDD. *Poa secunda* understory.....
Artemisia tridentata/Poa secunda community (P.23).

DDDD. *Stipa thurberiana* understory.....
Artemisia tridentata/Stipa thurberiana community (P.25).

DDDDD. *Chrysothamnus viscidiflorus* is a secondary-dominant to *Artemisia tridentata*, occurs on north, northeast, or east facing slopes at higher elevations .....
Artemisia tridentata/Chrysothamnus viscidiflorus community (P.21).

BB. Communities dominated by *Chrysothamnus nauseasus*.

C. *Chrysothamnus nauseasus* and *Artemisia tridentata* dominating the vegetation .....
Chrysothamnus nauseasus/Artemisia tridentata community (P.29)

BBB. Communities dominated by *Carex vesnacula*.

C. *Carex vesnacula* and *Poa ephis* dominating the vegetation.
..... *Carex vesnacule/Poa ephis* community (P.27).

Low Sagebrush (*Artemisia arbuscula*) Communities

1. *Artemisia arbuscula/Festuca idahoensis* Community

This community is encountered primarily on less accessible ridges and on very steep canyon walls where it alternates with talus strips.

The annual precipitation for this community was 10.1 inches (rain can 6, Appendix A). Elevation ranges from 5800 to 6220 feet. Aspect is usually north. Slope is 12 to 70 percent.

Low sagebrush (*A. arbuscula*) is the dominant shrub and occurs fairly uniformly throughout the community. Yellowbrush (*Chrysothamnus viscidiflorus*) occurs in fair amounts with big sagebrush (*Artemisia tridentata*) occurring only sporadically. Three-tipped sagebrush (*Artemisia tripartita*) is found in the community on the steep north facing canyon sides. Idaho fescue (*Festuca idahoensis*) is usually the most frequent grass, however, it is affected more by grazing than any other forage grass and Sandberg bluegrass (*Poa secunda*) may become the most frequent grass with a fair amount of squirreltail (*Sitanion hystrix*). Bluebunch wheatgrass (*Agropyron spicatum*) and thurber needlegrass (*Stipa thurberiana*) are also found in varied amounts. A large variety of forbs and a few additional grasses and shrub appear throughout the community (Table 1). This community is probably an *Artemisia arbuscula/Festuca idahoensis* habitat-type.

Rock accounts for 46.5 percent of the nonliving ground cover, litter for 36.0 percent, bareground for 9.0 percent and pavement for 8.5 percent (Table 2).

The soils at the macroplots where this vegetation was sampled are members of a clayey-skeletal, mixed, frigid family of Mollic Haplargids (Appendix B-6) or clayey-skeletal, mixed, frigid family of Lithic Mollic Haplargids (Appendix B-10).

Table 1. Species Cover and Frequency for the *Artemisia arbuscula/Festuca idahoensis* Community

Species	Cover %	20" x 20"* Frequency %
Artemisia arbuscula	5.3	39.0
Chrysothamnus viscidiflorus	3.5	28.5
Artemisia tridentata		9.0
Sympharicarpos longiflorus		1.0
Artemisia tripartita		t
Tetradymia canescens		t
Poa secunda	2.8	66.4
Festuca idahoensis	3.0	35.5
Sitanion hystrix		27.5
Agropyron spicatum		7.5
Stipa thurberiana		5.0
Melica bulbosa		1.0
Phlox longifolia		44.0
Erigerin pumilus		21.5
Eriogonum heermannii		16.0
Astragalus lentiginosus		15.5
Crepis occidentalis		15.0
Lygodesmia spinosa		11.0
Agoseris glauca		5.0
Erigeron bloomeri		9.0
Lupinus caudatus		4.5
Penstemon kingii		4.5
Collinsia parviflora		3.0
Lewisia rediviva		1.5
Lomatium sp.		1.5
Collomia grandiflora		1.0

*Frame size in inches

Table 2. Nonliving ground Cover for the *Artemisia arbuscula/Festuca idahoensis* Community.

Material	Cover %
Bareground	9.0
Litter	36.0
Pavement	8.5
Rock	46.5

2. *Artemisia arbuscula/Poa secunda* Community

This community occurs primarily in mountainous areas in the southeastern part of the watershed. It changes to *Artemisia tridentata* or *Artemisia longiloba* communities.

The annual precipitation for this community was 10.1 inches (rain can 17, Appendix A). Elevation ranges from 5300 to 6700 feet. It occurs on 1 to 10 percent slopes of all aspects.

Low sagebrush (*A. arbuscula*) dominates with Sandberg bluegrass (*Poa secunda*) being second in abundance and fairly uniformly distributed through the community. Cheatgrass (*Bromus tectorum*) has a relatively high frequency percent, but is erratic in occurrence. This species usually indicates a deteriorated condition. Highly palatable grasses such as Idaho fescue (*Festuca idahoensis*) and bluebunch wheatgrass (*Agropyron spicatum*) are fairly constant but contribute little to frequency or cover percentage. Big sagebrush (*Artemisia tridentata*) and yellowbrush (*Chrysothamnus viscidiflorus*) are present only in trace amounts. A large variety of forbs and a few additional grasses appear sporadically in the community (Table 3). This community is probably a very low seral (*Artemisia arbuscula/Festuca idahoensis*) habitat-type.

Litter accounts for 44.5 percent of the nonliving ground cover, rock for 26.0 percent, pavement for 15.5 percent and bareground for 14.0 percent.

The soils at the macroplots where this vegetation was sampled are members of the clayey-skeletal, mixed, frigid family of Lithic Mollic Haplargids (Appendix B-10) or fine, mixed, frigid family of the Mollic Durargids (Appendix B-13).

Table 3. Species Cover, Frequency and Constancy for the *Artemisia arbuscula/Poa secunda* Community

Species	Cover %	20 x 20'* Frequency %	Constancy %
Artemisia arbuscula	12.5	42.8	100
Artemisia tridentata		t	60
Chrysothamnus viscidiflorus		t	20
Symphoricarpos longiflorus		t	20
Poa secunda	1.1	48.7	100
Bromus tectorum		39.3	100
Sitanion hystrix		25.2	100
Agropyron spicatum		1.2	60
Festuca idahoensis		t	20
Melica bulbosa		t	20
Agoseris glauca		6.3	100
Phlox longifolia		54.6	80
Astragalus atratus		14.8	80
Blepharipappus scaber		11.2	80
Collinsia parviflora		7.8	80
Lewisia rediviva		1.8	80
Erigeron pumilus		11.1	60
Lomatium sp.		3.4	60
Crepis occidentalis		3.3	60
Lappula redowskii		2.0	60
Balsamorhiza hookeri		t	60
Trifolium gymnocarpon		8.9	40
Arabis holboellii		4.9	40
Erigeron bloomeri		1.8	40
Arenaria kingii		10.6	20
Allium acuminatum		5.4	20
Senecio integerrimus		4.0	20
Collomia grandiflora		1.8	20
Astragalus hornii			20
Chenopodium leptophyllum			20
Cirsium vulgare			20
Delphinium andersonii			20
Eriastrum diffusum			20
Lithophragma parviflora			20
Phlox diffusa			20

*Frame size in inches

Table 4. Nonliving Ground Cover for the *Artemisia arbuscula/Poa secunda* Community

Material	Cover %
Bareground	14.0
Litter	44.5
Pavement	14.5
Rock	26.0

Low Sagebrush (*Artemisia longiloba/Poa secunda*) Community

This community is located mostly in mountainous areas in the north and eastern part of the watershed. It changes to *Artemisia tridentata* or *Artemisia arbuscula* communities, and *A. tridentata* occurs as small inclusions within this community.

The annual precipitation for this community was 11.9 inches (rain cans 7, 8, 9, 11 and 12, Appendix A). Elevation ranges from 4950 to 6750 feet. It occurs on 1 to 4 percent slopes of all aspects.

Low sagebrush (*A. longiloba*) is the dominant shrub with other shrubs occurring only sporadically in the community. Sandberg bluegrass (*Poa secunda*) is the most frequent grass with squirreltail (*Sitanion hystrix*) and cheatgrass (*Bromus testorum*) being fairly abundant. The more palatable forage species such as Idaho fescue (*Festuca idahoensis*), bluebunch wheatgrass (*Agropyron spicatum*), thurber needlegrass (*Stipa thurberiana*) and oniongrass (*Melica bulbosa*) occur only in small erratic amounts. A large variety of forbs are encountered in the community. Longleaf phlox (*Phlox longifolia*) is the most abundant and highly constant. Other forbs like *Collinsia parviflora*, *Agoseris glauca* and *Lomatium* sp. are highly constant but contribute little to cover or frequency percentages (Table 5). This community is probably an *Artemisia longiloba/Festuca idahoensis* habitat-type.

Litter accounts for 62.4 percent of the nonliving ground cover, rock for 15.0 percent, bareground for 13.0 and pavement for 9.6 percent (Table 6).

The soils at the macroplots where this vegetation was sampled are members of a fine, mixed, frigid, family of Mollic Durargids (Appendix B-13); or clayey-skeletal, mixed, frigid family of Haplic Mollic Durargids (Appendix B-14).

Table 5. Species Cover, Frequency and Constancy for the *Artemisia longiloba/Poa secunda* Community.

Species	Cover %	20 x 20* Frequency %	Constancy %
Artemisia longiloba	15.6	33.0	100
Artemisia tridentata			22
Chrysothamnus viscidiflorus			22
Symphoricarpos longiflorus			22
Tetradymia canescens			11
Poa secunda	2.1	50.0	100
Sitanion hystrix		24.1	100
Bromus tectorum		24.4	67
Agropyron spicatum		2.7	67
Poa cusickii		3.7	56
Stipa thurberiana		2.0	56
Melica bulbose			33
Festuca idahoensis		1.6	22
Stipa comata			22
Elymus cinereus			11
Stipa columbiana			11
Phlox longifolia		54.8	100
Collinsia parviflora		14.9	100
Agoseris glauca		13.7	100
Lomatium sp.		10.2	100
Crepis acuminata		4.0	78
Senecio integerrimus		16.7	67
Lupinus caudatus		23.3	67
Crepis occidentalis		10.1	67
Arabis holboellii		3.1	67
Trifolium gymnocarpon		14.4	56
Balsamorhiza hookeri			56
Allium acuminatum			44
Delphinium andersonii			44
Erigeron bloomeri			44
Aster leucanthemifolius			33
Astragalus hornii			33
Collomia grandiflora			33
Erigeron pumilus		3.6	22
Allium atrorubens			22
Arabis sparsiflora			22
Astragalus atratus			22
Blepharipapus scaber			22
Mertensia obligifolia			22
Arenaria kingii			11
Astragalus purshii			11
Eriastrum diffusum			11
Lappula redowskii			11
Lupinus nevadensis			11
Mentzelia albicaulis			11

*Frame size in inches

Table 6. Nonliving Ground Cover for the *Artemisia longiloba/Poa secunda* Community

Material	Cover %
Bareground	13.0
Litter	62.4
Pavement	9.6
Rock	15.0

Big Sagebrush (*Artemisia tridentata*) Communities

1. *Artemisia tridentata/Agropyron spicatum* Community

This community is located in the northeastern part of the watershed. *Artemisia tridentata/Stipa thurberiana* community is found on the west and south.

The annual precipitation for this community was 8.3 inches (rain cans 4 and 5, Appendix A). Elevation ranges from 5100 to 5300 feet. Aspect is usually south but may be west. Slope is 2 to 25 percent.

Under proper management bluebunch wheatgrass (*Agropyron spicatum*) is found as the most abundant species. When overgrazing is allowed bluebunch wheatgrass disappears from the community and allows big sagebrush (*A. tridentata*) to increase and dominate the community. Thurber needlegrass (*Stipa thurberiana*) and *Penstemon kingii* also tend to increase with overgrazing. Grasses and forbs such as squirreltail (*Sitanion hystrix*), Sandberg bluegrass (*Poa secunda*), *Phlox longifolia* and *P. diffusa* are highly constant and have a relatively high frequency percentage.

Milkvetch (*Astragalus curvicarpus*), hawksbeards (*Crepis acuminata* and *C. occidentalis*), *Microsteris gracilis*, Great Basin wildrye (*Elymus cinereus*), and onion (*Allium attenuifolium*) are highly constant but contribute little to frequency or cover. Cheatgrass (*Bromus tectorum*), an invader species, is highly constant and has a fair frequency percentage. A large variety of forbs are scattered through the community but are not constant in their occurrence (Table 7). This community is probably an *Artemisia tridentata/Agropyron spicatum* habitat-type.

Bareground accounts for 53.0 percent of the nonliving ground cover, litter for 32.0 percent, rock for 8.0 percent, and pavement for 7.0 percent (Table 8).

The soils at the macroplots where the vegetation was sampled are members of a clayey-skeletal, mixed, frigid family of Mollic Haplargids (Appendix B-7), loamy-skeletal, mixed, frigid family of Mollic Durargids (Appendix B-12); or fine-loamy, mixed, frigid family of Mollic Haplargids (Appendix B-8).

Table 7. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Agropyron spicatum* Community

Species	Cover %	20 x 20* Frequency %	Constancy %
Artemisia tridentata	9.7	25.4	100
Chrysothamnus nauseosus			20
Eurotia lanata			20
Tetradymia glabrata			20
Agropyron spicatum	2.4	27.5	100
Sitanion hystrix		32.4	100
Poa secunda		28.3	100
Bromus tectorum		18.3	100
Stipa thurberiana			
Elymus cinereus		4.7	80
Oryzopsis hymenoides			20
Phlox diffusa		32.6	100
Astragalus curvicarpus		10.5	100
Crepis acuminata			100
Lomatium sp.			100
Phlox longifolia		25.9	80
Agoseris glauca		6.6	80
Crepis occidentalis		5.2	80
Allium attenuifolium		5.1	80
Microsteris gracilis		3.7	80
Penstemon kingii		2.5	80
Eriastrum diffusum		4.9	60
Astragalus lentiginosus			60
Chaenactis douglasii			60
Comandra pallida			60
Gilia sp.			60
Arabis holboellii			40
Astragalus purshii			40
Delphinium andersonii			40
Descurainia sophia			40
Erigeron pumilus			40
Eriogonum umbellatum			40
Lupinus caudatus			40
Aster scopulorum			20
Balsamorhiza hookeri			20
Balsamorhiza sagittata			20
Delphinium bicolor			20
Eriogonum sp.			20
Lappula redowskii			20
Leptodactylon pungens			20
Mentzelia dispersa			20

*Frame size in inches

Table 8. Nonliving Ground Cover for the *Artemisia tridentata/Agropyron spicatum* Community

Material	Cover %
Bareground	53.0
Litter	32.0
Pavement	7.0
Rock	8.0

2. *Artemisia tridentata/Bromus tectorum* Community

This community is located in the southeastern part of the watershed at lower elevations. East of Crowley Creek the community is encountered on steep slopes and to the west of Crowley Creek it is found on the first bench above the creek. The *Artemisia tridentata/Poa secunda* community is located on the west and *Artemisia tridentata/Agropyron spicatum* community on the north.

The annual precipitation of this community was 7.8 inches (rain cans 2 and 15, Appendix A). Elevation ranges from 4650 to 4800 feet. Aspect is usually west or southeast, but may be east. Slope is 2 to 53 percent.

Big sagebrush (*A. tridentata*) is the dominant shrub and is fairly uniform throughout the community. A variety of shrubs occur sporadically and contributes little to frequency or cover. Cheatgrass (*Bromus tectorum*) is the most frequent and highly constant grass. Squirreltail (*Sitanion hystrix*) and Sandberg bluegrass (*Poa secunda*) are fairly constant with relatively high frequency percentages. Other grasses are erratic in their occurrence. A variety of forbs occur throughout the community (Table 9). This community is located close to water and is obviously a low seral community. All of the better forage grasses have disappeared.

At the higher elevations and associated with the fine-loamy, mixed, mesic family of Mollic Haplargids this community is probably a seral expression of the *Artemisia tridentata/Agropyron spicatum* habitat-type. However, at lower elevations and associated with the coarse-loamy, mixed, mesic family of Entic Mollic Durorthids, it is probably an expression of the *Artemisia tridentata/Stipa thurberiana* habitat-type.

Litter accounts for 39.9 percent of the nonliving ground cover, bareground for 35.9 percent, rock for 15.7 percent, and pavement for 8.5 percent (Table 10).

The soils at the macroplots where this vegetation was sampled are members of a coarse-loamy, mixed, mesic family of Entic Mollic Durorthids (Appendix B-1), or fine-loamy, mixed, mesic family of Mollic Haplargids (Appendix B-5).

Table 9. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Bromus tectorum* Community

Species	Cover %	20 x 20* Frequency	%	Constancy	%
Artemisia tridentata	11.0	18.5		100	
Grayia spinosa				60	
Chrysothamnus viscidiflorus				40	
Artemisia spinescens				20	
Atriplex canescens				20	
Chrysothamnus nauseosus				20	
Tetradymia canescens				20	
Bromus tectorum		63.0		100	
Sitanion hystrix		10.5		80	
Poa secunda		8.0		80	
Stipa thurberiana		2/3		40	
Oryzopsis hymenoides				20	
Agropyron spicatum				20	
Cryptantha jamesii				40	
Leptodactylon pungens				40	
Descurania sopha				20	
Eriastrum diffusum				20	
Eriogonum deflexum				20	
Lygodesmia spinosa				20	
Phlox diffusa				20	
Senecio integerrimus				20	

* Frame size in inches

Table 10. Nonliving Ground Cover for the *Artemisia tridentata/Bromus tectorum* Community

Material	Cover %
Bareground	35.9
Litter	39.9
Pavement	8.5
Rock	15.7

3. *Artemisia tridentata/Chrysothamnus viscidiflorus* Community

This community is encountered primarily in the western part of the watershed on north or east facing slopes at the higher elevations. *Artemisia arbuscula* or *Artemisia longiloba* communities are found on the east and *A. longiloba* occurs as small inclusions within this community.

The annual precipitation for this community was 11.8 inches (rain cans 9, 10, and 16, Appendix A). Elevation ranges from 6100 to 6300 feet. Aspect is usually north, northeast or east. Slope is 1 to 8 percent.

Big sagebrush (*A. tridentata*) is the dominant species in the community. However, yellowbrush (*Chrysothamnus viscidiflorus*) is a secondary dominant. Sandberg bluegrass (*Poa secunda*) is the most frequent species in the understory, although it is not found uniformly throughout the community. Species such as lambstongue groundsel (*Senecio integerriums*), tailcup lupine (*Lupinus caudatus*), squirreltail (*Sitanion hystrix*), longleaf phlox (*Phlox longifolia*), and *Collinsia parviflora* are highly constant and have a fairly high frequency percentage. The more palatable grasses such as bluebunch wheatgrass (*Agropyron spicatum*), oniongrass (*Melica bulbosa*), letterman needlegrass (*Stipa lettermani*), and Williams needlegrass (*Stipa williamsii*) are fairly constant but contribute little to cover or frequency percentage. A large variety of forbs and a few additional grasses are found scattered throughout the community, but are erratic in occurrence (Table 13). This community is probably a low seral *Artemisia tridentata/Agropyron spicatum/Stipa lettermani* habitat-type.

Under "over-use" bluebunch wheatgrass, letterman needlegrass, Idaho fescue (*Festuca idahoensis*) and other palatable species have decreased allowing less palatable species such as yellowbrush, big sagebrush, lambstongue, and tailcup lupine to increase.

Litter accounts for 74.7 percent of the nonliving ground cover, bareground for 18.5 percent, rock for 3.5 percent, and pavement for 3.3 percent (Table 14).

The soil at the macroplots where this vegetation was sampled is a member of a fine-loamy, mixed, frigid family of the Typic Argixerolls (Appendix B-17).

Table 13. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Chrysothamnus viscidiflorus* Community

Species	Cover %	20 x 20* Frequency %	Constancy %
Artemisia tridentata	14.9	24.0	100
Chrysothamnus viscidiflorus	7.2	13.6	100
Symphoricarpos longiflorus		3.6	40
Artemisia longiloba	2.4	5.7	20
Artemisia arbuscula			20
Tetradymia canescens			20
Sitanion hystrix		27.4	100
Melica bulbosa		7.0	80
Agropyron spicatum		5.2	80
Poa secunda (12 x 12)*		34.1	60
Stipa lettermani		6.5	60
Stipa williamsii		3.9	60
Poa cussickii		4.6	40
Festuca idahoensis		3.7	20
Elymus cinereus			20
Poa nevadensis			20
Lupinus caudatus		35.2	100
Senecio integerrimus		27.3	100
Collinsia parviflora		25.4	100
Phlox longifolia		25.3	100
Agoseris glauca		15.2	100
Lomatium leptocarpum		6.0	100
Collomia grandiflora		12.5	80
Arabis holboellii			60
Delphinium andersonii			60
Mertensia obligifolia			60
Allium atrorubens			40
Astragalus hornii			40
Chenopodium leptophyllum			40
Crepis acuminata			40
Balsamorhiza sagittata		11.8	20
Arnica fulgens		4.8	20
Pedicularis bracteosa		3.8	20
Allium accminatum			20
Balsmorhiza hookeri			20
Descurainia sophia			20
Erigeron bloomeri			20
Erigonum heermannii			20
Lappula redowskii			20
Leptodactylon pungens			20
Lygodesmia spinosa			20
Penstemon speciosus			20
Phacelia humilis			20
Trifolium gymnocarpon			20

* Frame size in inches

Table 14. Nonliving Ground Cover for the *Artemisia tridentata/Chrysothamnus viscidiflorus* Community

Material	Cover %
Bareground	18.5
Litter	74.7
Pavement	3.3
Rock	3.5

4. *Artemisia tridentata/Poa secunda* Community

This community occurs primarily in terraced areas in the southeastern part of the watershed. *Artemisia tridentata/Stipa thurberiana* community is found on the west and *Artemisia tridentata/Bromus tectorum* community on the east.

The annual precipitation for this community was 8.2 inches (rain cans 13 and 15, Appendix A). Elevation is 5000 to 5100 feet. Aspect is usually east but may be southeast or south. Slope is 6 to 17 percent.

Big sagebrush (*A. tridentata*) is the dominant shrub with yellowbrush (*Chrysothamnus viscidiflorus*) occurring only sporadically. Cheatgrass (*Bromus tectorum*) is the most abundant grass with Sandberg bluegrass (*Poa secunda*) and squirreltail (*Sitanion hystrix*) highly constant and relatively frequent in their occurrence. The more palatable forage grasses such as blue bunch wheatgrass (*Agropyron spicatum*), thurber needlegrass (*Stipa thurberiana*) and Indian ricegrass (*Oryzopsis hymenoides*) occur only in small erratic amounts. A large variety of forbs are found in the community with *Collinsia parviflora*, *Eriastrum diffusum* and*Agoseris glauca* being the most constant in occurrence (Table 15). This community is probably an *Artemisia tridentata/Stipa thurberiana* habitat-type.

Litter accounts for 45.4 percent of the nonliving ground cover, bareground accounts for 16.6 percent, pavement and rock each for 19.0 percent (Table 16).

The soil at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, mesic family of Mollic Camborthids (Appendix B-3).

Table 15. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Poa secunda* Community

Species	Cover %	20 x 20* Frequency %	Constancy %
Artemisia tridentata	12.8	16.0	100
Chrysothamnus viscidiflorus		3.7	33
Bromus tectorum		65.7	100
Poa secunda		25.7	100
Sitanion hystrix		22.7	100
Stipa thurberiana			66
Agropyron spicatum			33
Oryzopsis hymenoides			33
Collinsia parviflora		9.3	100
Eriastrum diffusum		2.5	100
Agoseris glauca		2.0	100
Descurainia sophia		9.3	66
Chaenactis douglasii		5.0	66
Astragalus curvicarpa		2.3	66
Crepis acuminata			66
Delphinium andersonii			66
Phlox diffusa		12.2	33
Lappula redowskii		7.7	33
Phlox longifolia		7.3	33
Allium atrorubens			33
Astragalus hornii			33
Astragalus purshii			33
Crepis occidentalis			33
Eriogonum umbellatum			33
Leptodactylon pungens			33
Lomatium spp.			33
Lupinus nevadensis			33
Machaeranthera canescens			33

* Frame size in inches

Table 16. Nonliving Ground Cover for the *Artemisia tridentata/Poa secunda* Community

Material	Cover %
Bareground	16.6
Litter	45.4
Pavement	19.0
Rock	19.0

5. *Artemisia tridentata/Stipa thurberiana* Community

This community is located primarily in the south central part of the watershed. *Artemisia longiloba/Poa secunda* is usually found on the east, and on the west *Artemisia tridentata/Poa secunda* is encountered.

The annual precipitation for this community was 9.3 inches (rain cans 3, 6, 13 and 14, Appendix A). Elevation ranges from 4900 to 5300 feet. Aspect is usually southeast or east but it may be north or northeast. Slope is 1 to 6 percent.

Big sagebrush (*Artemisia tridentata*) is the dominant species in the community with other shrubs occurring only sporadically. Sandberg bluegrass (*Poa secunda*), Thurbers needlegrass (*Stipa thurberiana*) and squirreltail (*Sitanion hystrix*) are the most frequent species in the understory, with Sandberg bluegrass the most abundant. Cheatgrass (*Bromus tectorum*) occurs erratically throughout the community with bluebunch wheatgrass (*Agropyron spicatum*) and Great Basin wildrye (*Elymus cinereus*) occurring in trace amounts only. A large variety of forbs are found in the community, longleaf phlox (*Phlox longifolia*), *Agoseris glauca*, *Lomatium sp.* and *Eriastrum diffusum* the most frequent and highly constant (Table 17). At the higher elevations and associated with the fine, mixed, mesic family of Mollic Durargids this community is probably a seral expression of the *Artemisia tridentata/Agropyron spicatum* habitat-type. However, at lower elevations and associated with the fine-loamy, mixed, mesic family of Mollic Durorthids, it is probably an expression of the *Artemisia tridentata/Stipa thurberiana* habitat-type.

Litter accounts for 58.8 percent of the nonliving ground cover, bareground for 35.0 percent with rock and pavement accounting for very little cover (Table 18).

The soils at the macroplots where this vegetation was sampled are members of a fine, mixed, mesic, family of Mollic Durargids (Appendix B-11), or fine-loamy, mixed, mesic family of Mollic Durorthids (Appendix B-2).

Table 17. Species Cover, Frequency and Constancy for the *Artemisia tridentata/Stipa thurberiana* Community

Species	20 x 20* Cover %	Frequency %	Constancy %
Artemisia tridentata	14.7	35.6	100
Atriplex nuttallii			20
Chrysothamnus viscidiflorus			20
Grayia spinosa			20
Tetradymia canescens			20
Tetradymia glabrata			20
Poa secunda		44.9	100
Stipa thurberiana		31.0	100
Sitanion hystrix		25.5	80
Agropyron spicatum		3.4	80
Elymus cinereus		1.3	60
Bromus tectorum		21.1	40
Phlox longifolia		21.0	100
Agoseris glauca		9.0	100
Lomatium sp.		8.6	100
Eriastrum diffusum		7.9	100
Astragalus purshii			80
Lappula redowskii			80
Allium atrorubens		3.9	60
Astragalus hornii		3.6	60
Aster leucanthemifolium			60
Descuraina sophia			60
Allium acuminatum			40
Arabis holboellii			40
Collinsia grandiflora			40
Crepis acuminata			40
Delphinium andersonii			40
Eriogonum umbellatum			40
Lupinus caudatus			40
Mentzelia albicaulis			40
Phlox diffusa			40
Astragalus curvicarpus			20
Balsamorhiza hookeri			20
Crepis occidentalis			20

*Frame size in inches

Table 18. Nonliving Ground Cover for the *Artemisia tridentata/Stipa thurberiana* Community

Material	Cover %
Bareground	35.0
Litter	58.8
Pavement	4.2
Rock	2.0

Carex vesnacula/Poa ephis Community

The meadows are encountered mainly in the western part of the watershed. *Artemisia* communities are found on the better drained soils.

The annual precipitation for this community was 13.7 inches (rain can 11, Appendix A). Elevation is approximately 6100 feet. Aspect is northeast or northwest. Slope is 2 to 3 percent.

Carex vesnacula and *Poa ephis* dominate the meadow vegetation. However, *Monolepis nuttaliana* and *Phlox* sp. exhibit a fair cover and frequency percentage. Species such as *Potentilla arguta, Achillea lonulosa, Iris missouriensis, Taraxacum officinale,* and *Agroseris glauca* have a fairly low frequency and contribute little to cover. A variety of additional forbs are scattered throughout the meadow but are not constant (Table 19). This community is probably an *Carex vesnacula/Poa ephis* habitat-type.

Vegetation accounts for 85.7 percent of the ground cover. Bareground accounts for 8.0 percent and litter for 6.2 percent. There is no pavement and very little rock (Table 20).

The soil at the macroplots where this vegetation was sampled is a member of a fine, mixed, mesic family of Fluventic Hapaquolls (Appendix B-15).

Table 19. Species Cover and Frequency for the *Carex vesnacula/Poa ephis* Community

Species	Cover %	3 x 3* Frequency %	12 x 12* Frequency %
Artemisia tridentata	-	-	2.0
Carex vesnacula	44.2	61.5	-
Juncus balticus var. montanum	4.4	-	18.9
Poa ephis	16.9	42.5	-
Sitanion hystrix	-	-	0.8
Monolepis nuttaliana	12.8	27.5	-
Phlox sp.	8.0	18.8	-
Potentialla arguta	2.2	12.0	-
Iris missouriensis	2.1	-	6.2
Achillea lanulosa	1.0	-	6.2
Taraxacum afficinale			25.2
Agoseris glauca			18.2
Trifolium gymnocarpon			10.0
Arnica fulgens			5.5
Penstemon kingii			5.0
Comanda pallida			3.7
Iva axillaris			3.7
Phlox longifolia			0.2
Senecio integerrimus			0.2

* Frame size in inches

Table 20. Ground Cover Characteristics for the *Carex vesnacula/Poa ephis* Community

Material	Cover %
Bareground	8.0
Litter	6.2
Pavement	-
Rock	0.1
Vegetation	85.7

Chrysothamnus nauseosus/Artemisia tridentata Community

This community is encountered at the lower elevations of the watershed on both sides of Crowley Creek. *Artemisia tridentata/Bromus tectorum* community is found on the east and west as elevation increases.

The annual precipitation of this community was 7.7 inches (rain cans 1 and 2, Appendix A). Elevation ranges from 4500 to 4680 feet. Aspect is south and the slope is 3 to 4 percent.

Rubber rabbitbrush (*Chrysothamnus nauseosus*) and big sagebrush (*A. tridentata*) are the dominant species. Cheatgrass (*Bromus tectorum*) is highly frequent and occurs throughout the community, however, it is not uniform in occurrence. Species such as black greasewood (*Sarcobatus vermiculatus*), yellowbrush (*Chrysothamnus viscidiflorus*), spiny hopsage (*Grayia spinosa*), squirreltail (*Sitanion hystrix*), threadleaf sedge (*Carex filifolia*), and Great Basin wildrye (*Elymus cinereus*) occur in about one-third of the community and contribute little to cover or frequency percent. Big sagebrush, black greasewood, and rubber rabbitbrush are phreatophytes. This is obviously a very low seral community (Table 11). At one time probably considerably more grasses and less shrubby species were present, perhaps an *Artemisia tridentata/Elymus cinereus* habitat-type.

Litter accounts for 85.0 percent of the nonliving ground cover, bareground for 11.5 percent, pavement for 2.2 percent, and rock for 1.3 percent (Table 12).

The soil of the macroplots where this vegetation was sampled is a member of a fine-loamy, mixed, mesic family of Mollic Camborthids (Appendix B-4).

Table 11. Species Cover, Frequency and Constancy for the *Chrysothamnus nauseosus/ Artemisia tridentata* Community

Species	Cover %	20 x 20* Frequency %	Constancy %
Chrysothamnus nauseosus	25.3	17.9	100
Artemisia tridentata	9.4	29.2	100
Chrysothamnus viscidiflorus			33
Grayia spinosa			33
Sarcobatus vermiculatus			33
Bromus tectorum		62.7	100
Elymus cinereus			33
Sitanion hystrix			33
Carex filifolia			33

*Frame size in inches

Table 12. Nonliving Ground Cover for the *Chrysothamnus nauseosus/Artemisia tridentata* Community

Material	Cover %
Bareground	11.5
Litter	85.0
Pavement	2.2
Rock	1.3

Populus tremuloides Community

This community is found in the northern part of the watershed along Crowley Creek. It is a relatively small community and patchy in its occurrence.

The annual precipitation for this community was 8.3 inches (rain can 5, Appendix A). Elevation is around 5000 feet. Aspect is east and slope is 1 percent.

Quaking aspen (*P. tremuloides*) dominates the vegetation. However, *Rosa utramontana*, *Prunus* sp., and willow (*Salix caudata*) provide fairly good shrub cover. Western yarrow (*Achillea lanulosa*) has the highest cover in the understory, however, there is a fair cover of cheatgrass (*Bromus tectorum*). A variety of additional forbs and shrubs are scattered throughout the community but are not constant (Table 21). This community is probably a *Populus tremuloides*/ grass-forb habitat-type.

Vegetation accounts for 79.0 percent of the ground cover. Litter accounts for 13.5 percent and bareground for 7.5 percent (Table 22).

The soil at the macroplots where this vegetation was sampled is a member of a coarse-loamy, mixed, frigid family of Aquic Fluventic Haploxerolls (Appendix B-16).

Table 21. Species Cover for the *Populus tremuloides* Community.

Species	Cover %
Populus tremuloides	39.0
Rosa utramontana	26.0
Prunus sp.	13.0
Salix caudata	10.0
Rhus trilobata	3.0
Artemisia tridentata	3.0
Juncus balticus var. montanum	2.0
Bromus tectorum	10.5
Elymus glaucus	5.5
Achillea lanulosa	14.5
Taraxacum officinale	5.0
Monolepis nuttaliana	3.0
Amsinckia sp.	4.5
Galium sp.	1.5
Lappula redowskii	1.5

Table 22. Ground Cover Characteristics for the *Populus tremuloides* Community

Material	Cover %
Bareground	7.5
Litter	13.5
Pavement	-
Rock	-
Vegetation	79.0

DISCUSSION AND MANAGEMENT SUITABILITIES

Most of the communities in the watershed are seral. Some are in good condition while others are not. Table 23 presents a summary of the plant communities management suitabilities and Appendix C is a summary of the plant communities and associated soils. These summaries are discussed below.

The *Artemisia arbuscula/Festuca idahoensis* community in pristine condition once covered a much larger area. However, grazing has reduced it to relict areas restricted to less accessible ridges and canyon walls. The *A. arbuscula/Poa secunda* community represents the seral stage of the *A. arbuscula/F. idahoensis* community. Both occur on soils with a clay loam or clay Argillic horizon with or without a duripan or lithic contact. They may or may not have 35 percent particles coarser than 2 mm. (skeletal) (Appendix C). These communities are seral representatives of the *A. arbuscula/F. idahoensis* habitat-type. They should not be sprayed with 2,4-D without further experimentation. These sites should be managed for cattle, deer and antelope (Table 23).

The *Artemisia longiloba/Poa secunda* community is found mostly at higher elevations in the north and eastern part of the watershed. It is a low seral community that also occurs on soils with a clay Argillic horizon with or without a duripan. These soils have fine or clayey-skeletal textures. This community is most likely an *A. longiloba/F. idahoensis* habitat-type and is ecologically similar to the *A. arbuscula/F. idahoensis* habitat-type. This community should be sprayed with 2,4-D only on an experimental basis. Lined ponds could be developed in some of the draws to aid better livestock distribution and the community should be managed for cattle, deer and antelope.

In the northeastern part of the watershed an *Artemisia tridentata/Agropyron spicatum* community occurs on soils with a clay loam or clay Argillic horizon with or without a duripan. This community is an *A. tridentata/A. spicatum* habitat-type, has a fair understory of perennial grasses and would probably respond favorably to spraying with 2,4-D by airplane or helicopter. Also lined ponds could be developed to aid livestock distribution. It should be managed for cattle and antelope.

The *A. tridentata/Bromus tectorum* community is located in the southeastern part of the basin on both sides of Crowley Creek. Because of this closeness to water, livestock grazing has been heavy and most of the perennial grasses have disappeared. At the lower elevations this community occurs on soils with a fine sandy loam Cambic horizon and a duripan. This vegetation-soil unit is probably an *Artemisia*

Table 23. Crowley Creek Watershed Management
Suitabilities Table

Management Suitabilities	PLANT COMMUNITIES											
	Artemisia arbuscula/ Festuca idahoensis	*Artemisia arbuscula/ Poa secunda*	*Artemisia longiloba/ Poa secunda*	*Artemisia tridentata/ Agropyron spicatum*	*Artemisia tridentata/ Bromus tectorum*	*Artemisia tridentata/ Chrysothamnus viscidiflorus*	*Artemisia tridentata/ Poa secunda*	*Artemisia tridentata/ Stipa thurberiana*	*Carex vesnacula/ Poa ephis*	*Chrysothamnus nauseosus/ Artemisia tridentata*	*Populus tremuloides*
Plow and drill to crested wheatgrass *(Agropyron desertorum)* in the fall					X		X	X		X	
Spray with 2,4-D using an airplane or helicopter				X				X			
Spray with 2,4-D using a helicopter only						X					
Spray with 2,4-D on an experimental basis only	X	X	X								
Fence and install check dams									X		
Lined stock ponds			X	X		X		X			
Manage for sage grouse									X		
Manage for cattle	X	X	X	X	X	X	X	X	X	X	X
Manage for deer	X	X	X								X
Manage for antelope	X	X	X	X	X	X	X	X		X	

tridentata/Stipa thurberiana habitat-type. At higher elevations, however, this community occurs on soils with a clay loam Argillic horizon without a duripan. This vegetation-soil unit is probably a seral representation of the *A. tridentata/A. spicatum* habitat-type. On the more gentle slopes this community could be plowed and seeded to crested wheatgrass in the fall and manged for cattle and antelope.

At the higher elevations and on north and east facing slopes the *A. tridentata/Chrysothamnus viscidiflorus* community is encountered. This community occurs on soils with a clay loam Argillic horizon without a duripan but with a Mollic epipedon. This community is probably an *A. tridentata/A. spicatum/Stipa lettermani* habitat-type. This community has a fair understory of perennial grasses and would probably respond favorably to spraying with 2,4-D by helicopter. Also lined ponds developed in this community or in adjacent *A. longiloba/P. secunda* community would aid livestock distribution. The community should be managed for cattle and antelope.

The *A. tridentata/Poa secunda* and *A. tridentata/S. thurberiana* communities are located in the southeastern and south central part of the watershed. Both of these communities at lower elevations occur on soils with a loam or silt loam Cambic horizon with or without a duripan. Both of these vegetation-soil units probably represent the *A. tridentata/S. thurberiana* habitat-type. However, at higher elevations the *A. tridentata/S. thurberiana* community occurs on soils with a clay Argillic horizon with a duripan, and probably represents the seral stage of an *A. tridentata/S. spicatum* habitat-type. Both of these communities on the more gentle slopes could be plowed and drilled to crested wheatgrass in the fall and managed for cattle and antelope. In addition the *A. tridentata/S. thurberiana* community would probably respond favorably to spraying and lined ponds could be developed or existing ponds lined to aid livestock distribution.

The meadow (*Carex vesnacula/Poa ephis* community) occurs on a soil that is saturated with water at some period during the year, has mottles in the lower epipedon and has organic matter that does not decrease regularly with depth. It also has a Mollic epipedon. This community is probably a *C. vesnacula/P. ephis* habitat-type. Most of the meadows have been gullied and are being drained. Check dams would help to stop gullying and speed healing. The meadows should be fenced and managed for cattle and sage grouse.

At lower elevations and adjacent to Crowley Creek, a *Chrysothamnus nauseosus/A. tridentata* community has developed. It occurs on soils with silt loam Cambic horizons without a duripan. This vegetation-

soil unit is probably an *A. tridentata/Elymus cinereus* habitat-type. It could be plowed and seeded to crested wheatgrass in the fall and managed for cattle and antelope.

The *Populus tremuloides* community occurs at the bottom of a steep canyon along Crowley Creek in the northeastern part of the watershed. The soil is dry for 60 consecutive days or more in more than 7 out of 10 years in all parts of the soil between 7 and 20 inches. It does not have an Argillic horizon or a duripan and has organic matter that does not decrease regularly with depth. It also has a Mollic epipedon. This vegetation-soil unit is probably a *P. tremuloides*/Grass-forb habitat-type. It should be managed for cattle and deer.

CLIMAXES

Climax as used in this report is defined as the kind of community capable of perpetuation under the prevailing climatic, edaphic, physiographic or biotic condition. This definition is in accordance with the polyclimax concept where several climaxes constitute the vegetation in an area as the result of succession.

Climatic climax develops on land (moderately rolling to level) that is neither excessively nor inadequately drained, so that the major environmental conditions affecting organisms are climatic. Physiographic climax is determined in large measure by the nature of the topography (land relief). Edaphic climax is determined largely by the nature of the soil conditions. Physiographic-Edaphic climax is determined mostly by both topography and soils. Biotic climax is determined by the incidence and maintenance of a decisive "biotic factor" such as the continuous heavy grazing by animals (Hanson, 1962).

Most all of the communities in the watershed have been affected by heavy grazing use and areas of relatively undisturbed vegetation are not common. Consequently, a majority of the communities are biotic climaxes. For this reason an estimate of the climax of each community was based on their present condition and probable habitat-type (Table 24).

Table 24. Type of climaxes associated with the probable habitat-types and present biotic communities in the Crowley Creek Watershed

Probable Habitat-type and Biotic Communities	Type of Climax				
	Climatic	Physio-graphic	Edaphic	Physio-graphic-Edaphic	Biotic
A.[ab] *Artemisia arbuscula/Festuca idahoensis*				X	
1.[b] *A. arbuscula/Poa secunda*					X
B.[a] *Artemisia longiloba/F. idahoensis*				X	
1.[b] *A. longiloba/P. secunda*					X
C.[ab] *Artemisia tridentata/Agropyron spicatum*				X	
1.[b] *A. tridentata/Bromus tectorum*					X
2. *A. tridentata/Stipa thurberiana*					X
D.[a] *A. tridentata/A. spicatum/Stipa lettermani*				X	
1.[b] *A. tridentata/Chrysothamnus viscidiflorus*					X
E.[ab] *A. tridentata/S. thurberiana*	X				
1.[b] *A. tridentata/P. secunda*					X
F.[a] *A. tridentata/Elymus cinereus*			X		
1.[b] *Chrysothamnus nauseosus/A. tridentata*					X
G.[ab] *Carex vesnacula/Poa ephis*			X		
H.[a] *Populus tremuloides/Grass-forb*		X			
1.[b] *Populus tremuloides*					X

a Habitat-type
b Biotic community
ab Habitat-type and biotic community

RECREATION

The watershed is located far from any large population. At the present time this remoteness makes the watershed of little value for recreational development with the exception of hunting. Deer, antelope, sagebrouse and chucker have been seen on the watershed.

The basin has the advantage of a perennial stream and some shade trees at various spots along the creek. The grandeur of the vegetation, topographic features and wide open spaces may also attract a certain type of recreationist.

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APPENDIX A. Precipitation data for Crowley Creek Watershed.

Rain Can	Mean Annual Precipitation* (Inches)
1	7.6
2	7.8
3	8.3
4	8.3
5	8.3
6	10.1
7	10.5
8	10.7
9	12.5
10	13.4
11	13.7
12	11.9
13	8.6
14	10.1
15	7.9
16	9.3
17	10.1

Average annual precipitation for the watershed is 9.9 inches

*Mean Annual precipitation is based on a 4-year average, 1963-1966.

APPENDIX A (cont'd)

Community	Mean Annual Precipitation* (Inches)
Artemisia arbuscula/Festuca idahoensis	10.1
Artemisia arbuscula/Poa secunda	10.1
Artemisia longiloba/Poa secunda	11.9
Artemisia tridentata/Agropyron spicatum	8.3
Artemisia tridentata/Bromus tectorum	7.8
Artemisia tridentata/Chrysothamnus viscidiflorus	11.8
Artemisia tridentata/Poa secunda	8.3
Artemisia tridentata/Stipa thurberiana	8.3
Carex vesnacula/Poa ephis	13.7
Chrysothamnus nauseosus/Artemisia tridentata	7.7
Populus tremuloides	8.3

* Mean annual precipitation is based on rain cans in or near each community and on a 4-year record, 1963-1966

APPENDIX B-1

APPENDIX B. Soil Families and Subgroups as Associated with the Crowley Creek Watershed Plant Communities

Coarse-loamy, mixed, mesic, family of the Entic Mollic Durorthids

These soils are found at elevations from 4580 to 4800 feet and are associated with *Artemisia tridentata/Bromus tectorum* community. They are usually found on west or southeast facing slopes but may occur on east facing slopes. The slopes range from 2 to 12 percent with undulating macrorelief and uniform microrelief. These soils belong to the D hydrologic group and have a profile available waterholding capacity of 2.1 inches. Stoniness class is 0.

A 11	0-3"	Light gray (10YR7/2) fine sandy loam, brown (10YR4/3) moist; moderate fine platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 0.9 percent, conductivity 0.4 mmhos., cation exchange capacity 14.0 meq.; noneffervescent; neutral (pH 7.2), vesicular pores.
A 12	3-12"	Very pale brown (10YR7/3) fine sandy loam, dark yellowish brown (10YR4/4) moist; weak coarse prismatic; soft, very friable, nonsticky, nonplastic, noneffervescent; neutral (pH 7.2).
B 2*	12-21"	Very pale brown (10YR7/3) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak coarse prismatic; soft, very friable, nonsticky, nonplastic; organic matter 0.2 percent, conductivity 0.4 mmhos.; slightly effervescent; mildly alkaline (pH 7.6).
Csicam	21"+	Strongly cemented duripan

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* Cambic horizon

APPENDIX B-2

Fine-loamy, mixed, mesic family of the Mollic Durorthids

These soils are found at elevations around 5100 feet and are associated with *Artemisia tridentata/Stipa thurberiana* community. They are usually found on east facing slopes. The slopes are 2 to 3 percent with rolling macrorelief and convex microrelief. These soils belong to the D hydrologic group and have a profile available water holding capacity of 3.9 inches. Stoniness class is 0.

A 11	0-2"	Light brownish gray (10YR6/2) silt loam, brown (10YR4/3) moist; strong fine platy; slightly hard, very friable, slightly sticky, slightly plastic; organic matter 1.4 percent, conductivity 0.4 mmhos.; cation exchange capacity 14.0 meq.; noneffervescent; neutral (pH 7.2), vesicular pores.
A 12	2-6"	Pale brown (10YR6/3) loam, dark brown (10YR3/3) moist; weak coarse subangular blocky; soft, very friable, sticky, plactic; noneffervescent; neutral (pH 7.2).
B 2*	6-23"	Pale brown (10YR6/3) loam, dark brown (10YR3/3) moist; weak coarse subangular blocky; soft, very friable, slightly sticky, slightly plastic; organic matter 1.0 percent, conductivity 0.5 mmhos.; noneffervescent; mildly alkaline (pH 7.6).
Csicam	23"+	Indurated duripan.

* Cambic horizon

APPENDIX B-3

Coarse-loamy, mixed, mesic family of the Mollic Camborthids

These soils are found at elevations from 5000 to 5100 feet and are associated with *Artemisia tridentata/Poa secunda* community. They are usually found on west, south or southeast facing slopes. The slopes are 2 to 7 percent with rolling macrorelief and uniform microrelief. These soils belong to the B hydrologic group and have a profile available water holding capacity of 4.1 inches. Stoniness class is 1.

A 11	0-3"	Light gray (10YR7/2) fine sandy loam, yellowish brown (10YR5/4) moist; strong fine platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 2.4 percent; conductivity 0.5 mmhos.; cation exchange capacity 18.5 meq.; noneffervescent; mildly alkaline (pH 7.6); vesicular pores.
A 12	3-11"	Light gray (10YR7/2) silt loam, yellowish brown (10YR5/4) moist; weak medium subangular blocky; slightly hard, very friable, slightly sticky, noneffervescent; moderately alkaline (pH 8.3).
B 2*	11-21"	Very pale brown (10YR8/3) silt loam, pale brown (10YR6/3) moist; massive, hard, friable, slightly sticky, slightly plastic; organic matter 1.9 percent, conductivity 1.5 mmhos.; slightly effervescent; strongly alkaline (pH 8.8).
C_1	21-28"+	Very pale brown (10YR7/3) sandy loam, light yellowish brown (10YR6/4) moist; massive; soft, very friable, nonsticky, nonplastic; violently effervescent; moderately alkaline (pH 8.4).

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* Cambic horizon

APPENDIX B-4

Fine-loamy, mixed, mesic family of the Mollic Camborthids

These soils are found at elevations from 4500 to 4680 feet and are associated with *Chrysothamnus nauseosus/Artemisia tridentata* community. They are usually found on south facing slopes. The slopes range from 3 to 4 percent with undulating macrorelief and concave microrelief. These soils belong to the B hydrologic group and have a profile available water holding capacity of 10.8 inches. Stoniness class is 0.

A 1	0-4"	Light gray (10YR6/1) fine sandy loam, very dark brown (10YR2/2) moist; moderate medium platy; soft very friable, nonsticky, nonplastic; organic matter 3.0 percent, conductivity 1.0 mmhos.; cation exchange capacity 22.8 meq.; noneffervescent; moderately alkaline (pH 8.0); vesicular pores.
B2*	4-18"	Light grayish brown (10YR6/2) silt loam, very dark grayish brown (10YR3/2) moist; moderate coarse prismatic; slightly hard, very friable, slightly sticky, slightly plastic; organic matter 2.3 percent, conductivity 1.8 mmhos.; violently effervescent; strongly alkaline (pH 8.8).
C_1	18-64"+	Light grayish brown (10YR6/2) silt loam, very dark grayisn brown (10YR3/2) moist; weak coarse prismatic; hard, very friable, slightly sticky, slightly plastic; violently effervescent; moderately alkaline (pH 8.2).

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* Cambic horizon

APPENDIX B-5

Fine-loamy, mixed, mesic family of the Mollic Haplargids

These soils are found at elevations from 4580 to 4650 feet and are associated with *Artemisia tridentata/Bromus tectorum* community. They are usually found on west facing slopes. The slopes range from 32 to 53 percent with mountainous macrorelief and convex microrelief. These soils belong to the C hydrologic group and have a profile available water holding capacity of 5.3 inches. Stoniness class is 4.

A 11	0-4"	Light gray (10YR7/2) fine sandy loam, dark grayish brown (10YR4/2) moist; moderate medium platy; soft, very friable, nonsticky, nonplastic; organic matter 1.7 percent, conductivity 0.45 mmhos.; cation exchange capacity 14.2 meq.; noneffervescent; neutral (pH 7.2); vesicular pores.
A 12	4-9"	Light gray (10YR7/2) silt loam, dark grayish brown (10YR4/2) moist; weak medium prismatic; soft, very friable, slightly sticky, slightly plastic; non-effervescent; neutral (pH 7.2).
B 2t+	9-18"	Light yellowish brown (10YR6/4) clay loam, dark brown (10YR3/3) moist; moderate medium prismatic; hard, friable, very sticky, very plastic; organic matter 0.78 percent, conductivity 0.60 mmhos.; noneffervescent; mildly alkaline (pH 7.4).
B 3	18-25"	Pale brown(10YR6/3) silt loam, brown (10YR4/3) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; noneffervescent; mildly alkaline (pH 7.4).
C_1	25-30"+	Pale brown (10YR6/3) fine sandy loam, brown (10YR4/3) moist; massive; soft, very friable, nonsticky, non-plastic; noneffervescent; strongly alkaline (pH 8.6).

+ Argillic horizon

APPENDIX B-6

Loamy-skeletal, mixed, frigid family of the Mollic Haplargids

These soils are found at elevations around 5800 feet and are associated with *Artemisia arbuscula/Festuca idahoensis* community. They are usually found on north facing slopes. The slopes are around 70 percent with mountainous macrorelief and convex microrelief. These soils belong to the C. hydrologic group and have a profile available water holding capacity of 5.8 inches. Stoniness class is 4.

A 1	0-10"	Pale brown (10YR6/3) silt loam, brown (10YR4/3) moist; moderate fine granular; soft, very friable, slightly sticky, slightly plastic; organic matter 3.9 percent, conductivity 0.2 mmhos.; cation exchange capacity 20.2 meq.; noneffervescent; neutral (pH 6.8).
A 3	10-22"	Pale brown (10YR6/3) silt loam, brown (10YR4/3) moist; weak medium subangular blocky; soft, very friable, slightly sticky, slightly plastic; noneffervescent; neutral (pH 6.6).
B2t+	22-30"	Light brown (7.5YR6/4) clay loam, dark reddish brown (5YR3/3) moist; moderate fine subangular blocky; slightly hard, friable, sticky, plastic; organic matter 2.4 percent, conductivity 0.6 mmhos.; slightly effervescent; neutral (pH 7.2).
C	30-35"+	Pale brown (10YR6/3) silt loam, brown (7.5YR4/4) moist; massive; soft, very friable, slightly plastic; non-effervescent, neutral (pH 6.8).

+ Argillic horizon

APPENDIX B-7

Clayay-skeletal, mixed, frigid family of the Mollic Haplargids

These soils are found at elevations around 5000 feet and are associated with *Artemisia tridentata/Agropyron spicatum* community. They are usually found on west facing slopes. The slopes are around 30 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group and have a profile available water holding capacity of 6.0 inches. Stoniness class is 3.

A 1	0-4"	Light brownish gray (10YR6/2) loam, brown (10YR4/3) moist; strong fine platy; slightly hard, very friable, sticky, plastic; organic matter 1.4 percent, conductivity 0.4 mmhos.; cation exchange capacity 15.0 meq.; noneffervescent; neutral (pH 7.2); vesicular pores.
A 3	4-9"	Light brownish gray (10YR6/2) clay loam, dark brown (10YR3/3) moist; moderate fine granular; slightly hard, very friable, very sticky, very plastic; noneffervescent; mildly alkaline (pH 7.4).
B2t+	9-22"	Pale brown (10YR6/3) clay, dark yellowish brown (10YR 3/4) moist; strong fine subangular blocky; hard, firm, very sticky, very plastic; organic matter 1.3 percent, conductivity 0.4 mmhos.; noneffervescent; mildly alkaline (pH 7.6).
B3	22-31"	Light yellowish brown (10YR6/4) clay,dark yellowish brown (10YR4/4) moist; massive; hard, firm, very sticky, very plastic; noneffervescent; mildly alkaline (pH 7.8).
C	31-36"+	Yellow (10YR7/6) clay loam, dark yellowish brown (10YR4/4) moist; massive; slightly hard, friable, very sticky, very plastic; noneffervescent; strongly alkaline (pH 8.6).

+ Argillic horizon

APPENDIX B-8

Fine-loamy, mixed, frigid family of the Mollic Haplargids

These soils are found at elevations around 5100 feet and are associated with the *Artemisia tridentata/Agropyron spicatum* community. They are usually found on west facing slopes. The slopes are around 6 percent with rolling macrorelief and convex microrelief. These soils belong to the D hydrologic group with a profile available water holding capacity of 6.2 inches. Stoniness class is 3.

A 1	0-4"	Light gray (10YR7/2) fine sandy loam, grayish brown (10YR5/2) moist; moderate medium platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 1.5 percent, conductivity 0.2 mmhos.; cation exchange capacity 17.1 meq.; noneffervescent; mildly alkaline (pH 7.4); vesicular pores.
B21t	4-11"	Dark yellowish brown (10YR4/4) moist; clay; strong fine subangular blocky; hard, firm, very sticky, very plastic; organic matter 1.1 percent, conductivity 0.4 mmhos.; noneffervescent; moderately alkaline (pH 8.4).
B22t+	11-21"	Dark yellowish brown (10YR4/4) moist; clay; moderate medium prismatic; slightly hard, friable, very sticky, very plastic; slightly effervescent; moderately alkaline (pH 8.4).
B 3	21-31"	Brown (7.5YR4/4) moist; clay loam; massive, slightly hard, friable, sticky, plastic; slightly effervescent; moderately alkaline (pH 8.4).
Cca	31-39"+	Very pale brown (10YR8/3) sandy loam, light yellowish brown (10YR6/4) moist; massive; slightly hard, very friable, nonsticky, nonplastic; violently effervescent; strongly alkaline (pH 8.6).

+ Argillic horizon

APPENDIX B-9

Fine, mixed, frigid family of the Mollic Haplargids

These soils are found at elevations around 6600 feet and are associated with the *Artemisia longiloba/Poa secunda* community. They are usually found on east facing slopes. The slopes range from 1 to 8 percent with mountainous macrorelief and undulating microrelief. These soils belong to the D hydrologic group with a profile available water holding capacity of 5.2 inches. Stoniness class is 1.

A 1	0-4"	Light brownish gray (10YR6/2) silt loam, very dark grayish brown (10YR3/2) moist; strong fine platy; slightly hard, very friable, slightly sticky, slightly plastic; organic matter 3.5 percent, conductivity 0.1 mmhos.; cation exchange capacity 19.5 meq.; non-effervescent; slightly acid (pH 6.4).
A 3	4-12"	Light brownish gray (10YR6/2) loam, very dark grayish brown (10YR3/2) moist; weak coarse prismatic; slightly hard, very friable, sticky, plastic; noneffervescent; slightly acid (pH 6.4).
B 1	12-18"	Pale brown (10YR6/3) clay loam, dark brown (10YR3/3) moist; moderate medium prismatic; slightly hard, very friable, sticky, plastic; noneffervescent; neutral (pH 6.6).
B21t+	18-22"	Very pale brown (10YR8/3) clay, light yellowish brown (10YR6/4) moist; strong fine subangular blocky; hard firm, very sticky, very plastic; organic matter 1.2 percent, conductivity 0.3 mmhos.; noneffervescent; mildly alkaline (pH 7.4).
B22t	22-31"	Yellowish brown (10YR5/4) moist; clay; strong medium prismatic; hard, firm, very sticky, very plastic; noneffervescent; mildly alkaline (pH 7.6).
C_1	31-35"	Light yellowish brown (10YR6/4) moist; clay loam; massive; hard, friable, sticky, plastic; non-effervescent; mildly alkaline (pH 7.6).

+ Argillic horizon

APPENDIX B-10

Clayey-skeletal, mixed, frigid family of the Lithic Mollic Haplargids

These soils are found at elevations around 5700 feet and are associated with *Artemisia arbuscula/Poa secunda* and *Artemisia arbuscula Festuca idahoensis* communities. They are usually found on west facing slopes. The slopes range from 2 to 10 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group and have a profile available water holding capacity of 3.4 inches. Stoniness class is 3.

A 1	0-1"	Light brownish gray (10YR6/2) sandy loam, very dark grayish brown (10YR3/2) moist; strong fine platy; hard, friable, slightly sticky, slightly plastic, organic matter 2.4 percent, conductivity 0.4 mmhos.; cation exchange capacity 21.2 meq.; noneffervescent; neutral (pH 6.6); vesicular pores.
B 1	1-8"	Light grayisn brown (10YR6/2) clay, dark brown (10YR6/2) moist, weak medium prismatic; slightly hard, very friable, very sticky, very plastic; noneffervescent; neutral (pH 6.8).
B2t+	8-18"	Dark brown (7.5YR3.2) moist; clay; strong medium prismatic; very hard, very firm, very sticky, very plastic;organic matter 1.0 percent; conductivity 0.35 mmhos.; noneffervescent; neutral (pH 7.0).
R	18" +	Bedrock

+ Argillic horizon

APPENDIX B-11

Fine, mixed, mesic family of the Mollic Durargids

These soils are found at elevations around 5175 feet and associated with *Artemisia tridentata/Stipa thurberiana* community. They are usually found on south facing slopes. The slopes range from 1 to 3 percent with gentle sloping macrorelief and uniform microrelief. These soils belong to the D hydrologic group and have a profile available water holding capacity of 4.6 inches. Stoniness class is 0.

A 1	0-3"	Light gray (10YR7/2) silt loam, brown (10YR4/3) moist; moderate medium granular; soft, very friable, slightly sticky, slightly plastic; organic matter 3.6 percent, conductivity 0.6 mmhos.; cation exchange capacity 15.2 meq.; noneffervescent; neutral (pH 6.8), vesicular pores.
A 3	3-9"	Light brownish gray (10YR6/2) loam, brown (10YR4/3) moist; moderate fine platy, soft very friable, sticky plastic; noneffervescent; mildly alkaline (pH 7.6).
B2t+	9-21"	Light yellowish brown (10YR6/4) clay, dark brown (10YR3/3) moist; moderate medium prismatic; very hard, very fine, very sticky, very plastic; organic matter 0.9 percent, conductivity 1.5 mmhos.; non-effervescent; mildly alkaline (pH 7.8).
B3ca	21-27"	Yellow (10YR7/6) clay, brown (7.5YR4/4) moist; massive; slightly hard, friable, very sticky, very plastic; violently effervescent; strongly alkaline (pH 8.8).
Csicam	27"+	Indurated duripan

+Argillic horizon

APPENDIX B-12

Loamy-skeletal, mixed, frigid family of the Mollic Durargids

These soils are found at elevations around 5300 feet and are associated with *Artemisia tridentata/Agropyron spicatum* community. They are usually found on west facing slopes. The slopes are around 20 percent with rolling macrorelief and convex microrelief. These soils belong to the D hydrologic groups with a profile available water holding capacity of 1.3 inches. Stoniness class is 3.

A 11	0-2"	Light gray (10YR7/2) silt loam, grayish brown (10YR5/2) moist; strong medium platy; soft, very friable, slightly sticky, slightly plastic; organic matter 1.4 percent, conductivity 0.6 mmhos.; cation exchange capacity 12.2 meq.; noneffervescent; moderately alkaline (pH 8.3); vesicular pores.
A 12	2-5"	Light gray (10YR7/2) silt loam, dark grayish brown (10YR4/2) moist; moderate medium platy; soft, very friable, slightly sticky, slightly plastic; violently effervescent; moderately alkaline (pH 8.4).
B2t+	5-9"	Very pale brown (10YR7/3) clay loam, brown (10YR4/3) moist; moderate fine subangular blocky; slightly hard, friable, very sticky, very plastic; organic matter 1.2 percent, conductivity 0.2 mmhos.; violently effervescent; moderately alkaline (pH 8.4).
Csicam	9"+	Indurated duripan

+ Argillic horizon

APPENDIX B-13

Fine, mixed, frigid family of the Mollic Durargids

These soils are found at elevations from 5300 to 6000 feet and are associated with *Artemisia longiloba/Poa secunda* or *Artemisia arbuscula/Poa secunda* communities. They are usually found on east facing slopes. The slopes range from 1 to 8 percent with mountainous macrorelief and convex microrelief. The soils belong to the D hydrologic group and have a profile available water holding capacity of 3.8 inches. Stoniness class is 3.

A 1	0-3"	Light brownish gray (10YR6/2) clay loam, very dark grayish brown (10YR3/2) moist; strong medium platy; hard, friable, sticky, plastic; organic matter 2.8 percent, conductivity 0.4 mmhos.; cation exchange capacity 24.8 meq.; noneffervescent; neutral (pH 6.8); vesicular pores.
B 1	3-7"	Grayish brown (10YR5/2) clay,dark brown (10YR3/3) moist; weak medium prismatic; hard, friable, very sticky, very plastic; noneffervescent; neutral (pH 6.8).
B2t+	7-17"	Grayish brown (10YR5/2) clay, brown (10YR4/3) moist; strong medium prismatic; very hard, firm, very sticky, very plastic; organic matter 1.9 percent, conductivity 2.5 mmhos.; noneffervescent; neutral (pH 6.8).
B3	17-21"	Very pale brown (10YR7/4) clay, dark yellowish brown (10YR4/4) moist; moderate fine subangular blocky; hard friable, very sticky, very plastic, noneffervescent; neutral (pH 7.2).
Csicam	21"+	Indurated duripan.

+ Argillic horizon

APPENDIX B-14

Clayey-skeletal, mixed, frigid family of the Haplic Mollic Durargids

These soils are found at elevations around 6200 feet and are associated with *Artemisia longiloba/Poa secunda* Community. They are usually found on east facing slopes. The slopes are around 6 percent with mountainous macrorelief and convex microrelief. These soils belong to the D hydrologic group and have a profile available water holding capacity of 3.1 inches. Stoniness class is 3.

A 1	0-3"	Light brownish gray (10YR6/2) loam, dark brown (10YR3/3) moist; moderate fine platy; slightly hard, friable, sticky, plastic; organic matter 3.1 percent, conductivity 0.35 mmhos.; cation exchange capacity 16.8 meq.; noneffervescent; neutral (pH 6.8); vesicular pores.
B1	3-9"	Pale brown (10YR6/3) clay loam, dark brown (10YR3/3) moist; weak medium prismatic; slightly hard, friable, very sticky, very plastic; noneffervescent, neutral (pH 6.6).
B2t+	9-17"	Reddish brown (5YR4/4) moist; clay, strong medium platy; very hard, very firm, very sticky, very plastic; organic matter 1.1 percent, conductivity 0.4 mmhos.; noneffervescent; neutral (pH 6.8).
Csicam	17"+	Strongly cemented duripan.

+ Argillic horizon

APPENDIX B-15

Fine, mixed, mesic family of the Fluventic Hapaquolls

These soils are found at elevations around 6400 feet and are associated with *Carex vesnacula/Poa ephis* community. They are found usually on east facing slopes. The slopes range from 2 to 4 percent with undulating macrorelief and convex microrelief. These soils belong to the D hydrologic group and have a profile available water holding capacity of 9.1 inches. Stoniness class is 0.

A 1	0-3"	Grayish brown (10YR5/2) loam, black (10YR2/1) moist; weak medium subangular blocky; soft, very friable, slightly sticky, nonplastic; organic matter 10.0 percent, conductivity 0.7 mmhos.; cation exchange capacity 46.2 meq.; noneffervescent; slightly acid (pH 6.2).
A 3	3-10"	Grayish brown (10YR5/2) clay loam, black (10YR2/1) moist; weak medium prismatic; hard, friable, sticky, plastic; noneffervescent, slightly acid (pH 6.2).
II AC	10-49"	Black (10YR2/1) moist, clay; strong prismatic; very hard, very firm, very sticky, very plastic, organic matter 0.5 percent, conductivity 0.3 mmhos.; non-effervescent; mildly alkaline (pH 7.6); mottles.
C	49"+	Very dark gray (10YR3/1) moist; fine sandy loam; massive; slightly hard, friable, nonsticky, non-plastic, noneffervescent.

APPENDIX B-16

Coarse-loamy- mixed, frigid family of the Aquic Fluventic Haploxerolls.

These soils are found at elevations around 5400 feet and are associated with *Populus tremuloides* community. They are usually found on east facing slopes. The slopes are around 1 percent with mountainous macrorelief and irregular microrelief. These soils belong to the B hydrologic group with a profile available water holding capacity of 7.1 inches. Stoniness class is 0.

A 11	0-12"	Grayish brown (10YR5/2) silt loam, very dark brown (10YR2/2) moist; moderate fine subangular blocky; soft, very friable, slightly sticky, slightly plastic, organic matter 7.6 percent, conductivity 0.7 mmhos.; cation exchange capacity 40.0 meq.; noneffervescent; neutral (pH 6.8).
A 12	12-33"	Grayish brown (10YR5/2) silt loam, very dark brown (10YR2/2) moist; weak medium subangular blocky; soft, very friable, noneffervescent; slightly acid (pH6.4).
C	23-38"+	Black (10YR2/1) moist; silt loam, massive; soft, very friable, slightly sticky, slightly plastic, noneffervescent; slightly acid (pH 6.2); mottles.

APPENDIX B-17

Fine-loamy, mixed, frigid family of the Typic Argixerolls

These soils are found at elevations around 6150 feet and are associated with *Artemisia tridentata/Chrysothamnus viscidiflorus* community. They are usually found on the north or east facing slopes. The slopes are around 8 percent with mountainous macrorelief and concave microrelief. The soils belong to the C hydrologic group with a profile available water holding capacity of 6.5 inches. Stoniness class is 0.

A 11	0-3"	Dark grayish brown (10YR4/2) fine sandy loam, very dark brown (10YR2/2) moist; moderate medium platy; slightly hard, very friable, nonsticky, nonplastic; organic matter 3.0 percent; conductivity 0.45 mmhos.; cation exchange capacity 23.8 meq.; noneffervescent; slightly acid (pH 6.2).
A 12	3-12"	Dark grayish brown (10YR4/2) silt loam, very dark brown (10YR2/2) moist; weak coarse platy, soft, very friable, slightly sticky, slightly plastic, non-effervescent; slightly acid (pH 6.2).
B2t+	12-21	Grayish brown (10YR5/2) clay, very dark grayish brown (10YR3/2) moist; moderate fine subangular blocky; hard, friable, sticky; organic matter 2.6 percent, conductivity 0.2 mmhos.; noneffervescent; slightly acid (pH 6.4).
B3	21-32"	Grayish brown (10YR5/2) clay loam, very dark grayish brown (10YR3/2) moist; massive; slightly hard, very friable, sticky, plastic, noneffervescent; slightly acid (pH 6.4).
C	32-38"+	Brownish yellow (10YR6/6) moist; clay loam, massive; slightly hard, very friable, sticky, plastic, non-effervescent; slightly acid (pH 6.4).

+ Argillic horizon

APPENDIX C

PLANT COMMUNITIES AND SOILS ASSOCIATION TABLE
For Crowley Creek Watershed

PLANT COMMUNITIES AND SOILS ASSOCIATION TABLE
For Crowley Creek Watershed

PLANT COMMUNITIES	SOILS																					
	DURORTHIDS		CAMBORTHIDS		DURARGIDS				HAPLARGIDS						HAPA-QUOLLS	HAPLO-XEROLLS	ARGIXE-ROLLS					
	Coarse-loamy, mixed, mesic family of the Entic Mollic Durorthids	Fine-loamy, mixed, mesic family of the Mollic Durorthids	Coarse-loamy, mixed mesic family of the Mollic Camborthids	Fine-loamy, mixed mesic family of the Mollic Camborthids	Fine, mixed, mesic family of the Mollic Durargids	Loamy-skeletal, mixed frigid family of the Mollic Durargids	Fine, mixed, frigid family of the Mollic Durargids	Clayey-skeletal, mixed frigid family of the Haplic Mollic Durargids	Fine-loamy, mixed mesic family of the Mollic Haplargids	Loamy-skeletal, mixed, frigid family of the Mollic Haplargids	Clayey-skeletal, mixed, frigid family of the Mollic Haplargids	Fine-loamy, mixed, frigid family of the Mollic Haplargids	Fine, mixed, frigid family of the Mollic Haplargids	Clayey-skeletal, mixed frigid family of the Lithic Mollic Haplargids	Fine, mixed, mesic family of the Fluventic Hapaquolls	Coarse-loamy, mixed, frigid family of the Aquic Fluventic Haploxerolls	Fine-loamy, mixed, frigid family of the Typic Argixerolls				
Artemisia arbuscula/ Festuca idahoensis										X				X								
Artemisia arbuscula Poa secunda							X							X								
Artemisia longiloba/ Poa secunda							X	X					X									
Artemisia tridentata/ Agropyron spicatum						X					X	X										
Artemisia tridentata/ Bromus tectorum	X								X													
Artemisia tridentata/ Chrysothamnus viscidiflorus																	X					
Artemisia tridentata/ Poa secunda			X																			
Artemisia tridentata/ Stipa thurberiana		X			X																	
Carex vesnacula/ Poa ephis															X							
Chrysothamnus nauseosus/ Artemisia tridentata				X																		
Populus tremuloides																X						

CROWLEY CREEK WATERSHED

Vegetation Mapping Units and Precipitation Recording Stations

Scale 1:3168

1 .5 0 1 2 Miles

R. 34E. R. 35E. R. 36E.

T. 46N. T. 45N. T. 44N.

N

Precipitation Recording Stations

Legend

- ■ Recorder
- ▲ Peak Flow Gauge
- ● Rain Can

Road

Legend

Unimproved Dirt ======

Vegetation Mapping Units

Legend

Symbol	%	
	100	Artemisia arbuscula / Festuca idahoensis
	25	Artemisia arbuscula / Festuca idahoensis
	75	Talus Slopes
	85	Artemisia arbuscula / Poa secunda
	15	Artemisia tridentata / Chrysothamnus viscidiflorus
	100	Artemisia longiloba / Poa secunda
	85	Artemisia longiloba / Poa secunda
	15	Artemisia tridentata / Chrysothamnus viscidiflorus
	65	Artemisia longiloba / Poa secunda
	35	Artemisia tridentata / Chrysothamnus viscidiflorus
	100	Artemisia tridentata / Agropyron spicatum
	100	Artemisia tridentata / Bromus tectorum
	90	Artemisia tridentata / Chrysothamnus viscidiflorus
	10	Artemisia longiloba / Poa secunda
	65	Artemisia tridentata / Chrysothamnus viscidiflorus
	35	Artemisia longiloba / Poa secunda
	100	Artemisia tridentata / Poa secunda
	100	Artemisia tridentata / Stipa thurberiana
	100	Chrysothamnus nauseosus / Artemisia tridentata

The Carex vesicaria / Poa ephis and Populus tremuloides Communities Are <1% of Any One Mapping Unit And Are Not Noted on The Map.

Upper Recorder

Lower Recorder

Prepared by W.H. Blackburn 1968, Renewable Resources Center, University of Nevada; From Bureau of Land Management Base Map.